PROC. ENTOMOL. SOC. WASH.
97(1), 1995, pp. 90–111

NATIVE BLACK GRASS BUGS (*IRBISIA-LABOPS*) ON INTRODUCED WHEATGRASSES: COMMENTARY AND ANNOTATED BIBLIOGRAPHY (HEMIPTERA: HETEROPTERA: MIRIDAE)

JOHN D. LATTIN, ANNE CHRISTIE, AND MICHAEL D. SCHWARTZ

(JDL) Systematic Entomology Laboratory, Department of Entomology, Oregon State University, Corvallis, Oregon 97331-2907, U.S.A.; (AC) William Jasper Kerr Library, Oregon State University, Corvallis, Oregon 97331-4501, U.S.A.; (MDS) Centre for Land and Biological Resources Research, Biological Resources Division, Research Branch, Agriculture Canada, Ottawa, Ontario, K1A 0C6, Canada.

Abstract.—The introduction of crested wheatgrasses (*Agropyron* spp.) into North America to improve the carrying capacity of western rangelands resulted in unanticipated increases in the population levels of native black grass bugs (*Irbisia* spp. and *Labops* spp.). The more than two hundred publications, reports, and theses listed in this annotated bibliography contain information on the systematics, biology, and ecology of the bugs and management techniques for controlling and minimizing bug damage to these non-indigenous species of wheatgrasses.

Key Words: Black grass bugs, *Irbisia, Labops,* Hemiptera: Heteroptera, Miridae, plant bugs, bibliography, rangeland, non-indigenous species, wheatgrasses, *Agropyron*

INTRODUCTION

Grasslands play an important environmental role worldwide. Over 7 billion hectares occur, including rangeland and pasture, exceeding forests and woodlands by over one-half billion hectares (Lauenroth 1979, Turner and Meyer 1992). Grasslands of all types have always received extraordinary use as a resource for grazing by both wild and domestic animals (Crawley 1983).

The area occupied by grasslands globally declined from 1700 to 1980, chiefly because the land was being converted to other agricultural uses, largely croplands. Grassland areas have increased since 1950, primarily at the expense of forests and woodlands (Turner and Meyer 1992). Such shifts in global carbon storage patterns are becoming more apparent and the consequences of these conversions are attracting worldwide concern.

This paper addresses the interaction between several groups of native grass insects—the black grass bugs (Hemiptera: Heteroptera: Miridae) and range grasses, chiefly non-indigenous species that have been planted widely throughout western North America for range improvement. Most of the annotated references deal with some aspect of the habits and characteristics of plant bugs of the genera *Irbisia* Reuter and *Labops* Burmeister.

While no simple solution to the problems caused by these insects emerged from this review, we have documented the diverse interactions between introduced organisms (here, several grass species from Central Asia) and elements of the native insect fauna, some with close relatives in the original

home of the grasses. While it is more common for crop pests to be non-indigenous themselves, host plant shifts of native insects onto introduced plant species do occur (Kogan and Lattin 1993). The basic problem of damage to the planted wheatgrass species results from these host shifts. The bugs continue to feed on their native hosts, of course, but the coevolution of these insects with their native hosts generally results in resistance to extensive damage by the bugs. This resistance normally is not present in the introduced grass species. Breeding programs for rangeland grasses have tended to emphasize agronomic improvements rather than resistance to insects (Watts et al. 1982).

If, at the time of original introduction of the wheatgrasses, a thorough review of potential pests had been made, it would have disclosed that at least one native species of *Labops* found in Central Asia feeds upon species of *Agropyron* Gaertn. (Kerzhner 1973). This example illustrates the desirability of careful screening of plant materials (and, of course, animals) *before* their introduction to new regions.

Historical Background

The grasses

Dillman (1946) provided a detailed account of the introduction of the crested wheatgrasses into North America. N. E. Hansen of the U.S. Department of Agriculture first encountered crested wheatgrasses in Asia when he visited the Valuiki Experiment Station about 150 miles north of St. Petersburg in 1897–1898. These grasses (*Agropyron* spp.) were already being raised and tested for cultivation by Vasili S. Bogdan. Hansen obtained seed samples to be tested upon his return to the United States. Samples were sent to five different states but information about the results of these early plantings is scarce.

A second shipment provided by Bogdan arrived in late 1906. This was the one that led to the successful planting and distribution of crested wheatgrass in North America. One lot was labeled *Agropyron cristatum* (L.) Gaertn. and five lots were labeled *A. desertorum* (Fisch.) Schult. The second shipment was divided and sent to 15 experiment stations from 1907 to 1913. According to Dillman (1946) "All evidence thus far collected points to the conclusion that the successful plantings made at the Belle Fourche Station, Newell, S. Dak., from 1908 to 1915, and the experiments begun in 1915 at the Northern Great Plains Field Station, Mandan, N. Dak., were responsible for the early distribution and establishment of crested wheatgrass in the northern Great Plains." Love and Hanson (1932) provided an early treatment on the life history of crested wheatgrass and included a key to identify the species then involved. Dewey (1983) reviewed the taxonomy of wheatgrass and related grasses. Barkworth and Dewey (1985) provided an overview of the perennial Triticeae of North America, including the crested wheatgrasses.

Although Rogler and Lorenz (1983) extolled the virtues of crested wheatgrass as being just about the perfect range grass, they did suggest that some improvements were possible and needed—including insect resistance. Most of the references included below are related to insect problems of only one type—black grass bugs, mainly as pests of crested wheatgrasses. One wonders how intensive breeding programs using native grasses might have resulted in breeding lines of similar forage desirability.

The bugs

The insects belong to the family Miridae (Hemiptera: Heteroptera), the largest family of the true bugs, about 2000 species are known from Canada and the United States (Henry and Wheeler 1988). While most of the species are herbivorous, some are predaceous and some feed on both plants, insects and other arthropods. Several genera have species that feed on grasses. Most of

these genera are found in the tribe Stenodemini, subfamily Mirinae. Some of these genera are mentioned in the papers below, including *Leptopterna* Fieber, *Litomiris* Slater, *Stenodema* Laporte, and *Trigonotylus* Fieber. Also mentioned in several papers is *Conostethus* Fieber, a genus that is placed in the tribe Phylini, subfamily Phylinae.

The two genera discussed here as black grass bugs are *Irbisia* (Mirinae: Mirini) and *Labops* (Orthotylinae: Halticini). Some of the earlier literature referred to species of the genus *Thyrillus* Uhler, but this genus was synonymized with *Irbisia* many years ago.

The species of *Irbisia* and *Labops* that feed on crested wheatgrasses are all native species. The only non-indigenous species of bug mentioned in the literature reviewed here is *Leptopterna dolabrata* (Fallén), the meadow plant bug, a species introduced into North America many years ago from Europe. There are other non-indigenous species of mirids that are known to feed upon grasses in North America (Wheeler and Henry 1992); they were not included in this annotated bibliography.

Irbisia Reuter, 1879, contains 23 species (Schwartz 1984); all of the species are found in North America, mainly in the western provinces and states. The currently accepted species are *I. bliveni* Schwartz, 1984, *I. brachycera* (Uhler), 1872, *I. californica* Van Duzee, 1921, *I. cascadia* Schwartz, 1984, *I. castanipes* Van Duzee, 1921, *I. cuneomaculata* Van Duzee, 1934, *I. elongata* Knight, 1941, *I. fuscipubescens* Knight, 1941, *I. incomperta* Bliven, 1963, *I. knighti* Schwartz and Lattin, 1984, *I. limata* Bliven, 1963, *I. mollipes* Van Duzee, 1917, *I. nigripes* Knight, 1925, *I. oreas* Bliven, 1963, *I. pacifica* (Uhler), 1872, *I. panda* Bliven, 1963, *I. sericans* (Stål), 1858, *I. serrata* Bliven, 1963, *I. setosa* Van Duzee, 1921, *I. shulli* Knight, 1941, *I. silvosa* Knight, 1961, *I. sita* Van Duzee, 1921, *I. solani* (Heidemann), 1910. The only species of this genus not restricted to North America is *I. sericans* whose range extends into eastern Siberia (Kulik 1965, Vinokurov 1979, Kerzhner 1988).

Several species of *Irbisia* have been reported from the crested wheatgrasses as well as other graminoid plants and, in fact, from other types of plants besides the grasses. Species of *Irbisia* often shift from grasses to other plants late in their adult stage, sometimes to crops of economic importance. Eggs of some bug species are placed in grass stems while other bug species have been reported to deposit their eggs in non-graminoid plants (Schwartz 1984). Before the genus was revised, references were often made only to the genus rather than to a particular species, although *I. pacifica* was often cited because it was abundant and distinctive in appearance. The revision by Schwartz (1984) placed the taxonomy of *Irbisia* upon stable ground.

Labops Burmeister, 1835, contains 12 species and occurs in both the Old and New Worlds (Carvalho 1958, Kerzhner 1988) with one species, *L. burmeisteri* Stål, present in both regions (Kulik 1965, Vinokurov 1979, Kerzhner 1988). Seven species are found only in North America. The currently accepted species of *Labops* occurring in North America are: *L. brooksi* Slater, 1954, *L. burmeisteri* Stål, 1858, *L. chelifer* Slater, 1954, *L. hesperius* Uhler, 1872, *L. hirtus* Knight, 1922, *L. tumidifrons* Knight, 1922, *L. utahensis* Slater, 1954, *L. verae* Knight, 1929. Of these, only *L. hesperius, L. hirtus,* and *L. utahensis* have been reported from crested wheatgrasses. The most economically important species is *L. hesperius.* The other two species of *Labops* may be important in more limited areas, especially *L. utahensis.*

Management Considerations

Many papers deal with different methods of coping with the damage caused to the grasses by species of *Irbisia* and *Labops,* depending chiefly on the geographic area.

While insecticide treatments have been used at different times and places in the past, emphasis has shifted towards cultural control, partly because of cost and partly because many compounds used previously are no longer available or registered. Further, the widespread use of pesticides has been deemphasized for environmental reasons. Nontarget organisms are receiving much greater attention, especially in seminatural settings such as rangelands.

The main management efforts seem to be in the timing of grazing and in the manipulation of the planting mixtures related to the natural vegetation. Pure stands of crested wheatgrass are more likely to sustain greater damage than range that maintains a diversity of species more nearly approximating original conditions (Spangler and MacMahon 1990). Increased efforts to breed resistant strains and to elucidate the nature of this resistance are occurring. Much, however, remains to be done in developing breeding programs for improving native grasses. The original wheatgrasses brought in were first located at a research station in Central Asia where they were being raised for selection for superior varieties in that area.

The consequences of introducing several non-indigenous grass species (*Agropyron* spp.) into western North America have been their widespread use as replacements or augmentations for native grass species, at times approaching monocultures. While this has improved the carrying capacity of many rangelands, it has often been at the expense of the native grasses, species often well adapted to particular localities throughout this vast portion of the continent. The diversity of native grass species found throughout this region attests to the selection and adaptation that occurred through time, resulting in well-adapted forms. Some of these grasses were unable to withstand the grazing pressures to which they have been subjected, and the introduced grasses seemed to hold the answer to increasing the carrying capacity of these rangelands (Perry 1954).

As is often the case, planting a virtual monoculture within a highly diverse flora may create new problems. Expecting one or two species to replace a vast mosaic of grass species adapted over thousands of years to particular conditions may be unrealistic. For example, native insects whose populations were maintained at reasonable levels because of the diversity of grass species normally found in any given area often responded to this newly created monoculture by increasing in density.

Natural controls that helped maintain lower population levels of the insects that feed on native grasses may not have been able to sustain those lower levels because of the sudden abundance of new host plants. The increased densities of the insects, of course, reduced the very resources and benefits the plantings were supposed to provide. Many of the references included here document the differences in insect population levels between planted and unplanted rangeland.

Some obvious parallels exist between newly created insect problems on modified rangelands and more conventional agricultural practices. When native vegetation of any sort is converted to croplands, changes in the biota occur (Kogan and Lattin 1993). Monocultures do not resemble most natural vegetational patterns. Usually planted in high density for convenience of harvest, such artificial environments create conditions that often result in rapid build-up of pests, generally at population levels far above what might otherwise occur. Natural control mechanisms in the form of parasites and predators are usually rendered ineffective because the very situation that allowed these controls to function has been disrupted. A long-term consequence of the change to vast monocultures of crops of all types has been a gradual increase in reliance upon a variety of chemicals to provide the levels of control expected. After many years of this depen-

dency and the development of pesticide resistance and the impact of pesticides on the environment, we are again examining alternative approaches. The emergence of Integrated Pest Management (IPM) is gaining in popularity and in sophistication. It holds real promise in rangeland management where some semblance of native/natural conditions still exists in contrast to a cornfield, for example. With all of the various breeding programs involving the introduced crested wheatgrasses, one wonders what might have happened if similar efforts had been applied to our diverse native grass flora.

Conclusions

It is unlikely that the black grassbug/crested wheatgrass problem will ever be resolved completely. The non-indigenous grasses have been planted so widely that they are unlikely to be replaced or displaced. The native bugs are not likely to disappear either. They have been and continue to be well adapted to the grasslands of western North America. The presence of crested wheatgrasses simply provides additional resources and most likely supports higher population levels than existing undisturbed grasslands. Based on the bulk of the investigations reviewed for this publication, it appears that the most likely improvement will occur by moving away from monocultures. Bug populations should decrease as habitats become more heterogeneous. Increased resistance of some varieties of wheatgrasses seems likely to help (e.g. Levin 1973, Ling et al. 1985), as will careful attention to grazing pressures—especially when less than ideal climatic conditions follow heavy attack by the bugs. Increased attention to greater diversity of native grasses already adapted to local conditions provides yet another possibility; the best approach to ameliorating the problem appears to be an ecosystem approach to management rather than relying on only a few factors. It seems that the use of pesticides is more and more unlikely for a variety of reasons. True integrated pest management may be the best approach to this complex problem (Watts et al. 1982).

Acknowledgments

We extend our special thanks to George G. Hewitt, U.S. Department of Agriculture (retired) for suggesting this project and for his early efforts on it and to Connie J. L. Foiles, U.S. Department of Agriculture, for her help on the earlier portions of this work. We thank the many authors and librarians who responded to our requests for papers and information and especially Ted Evans, Utah State University; Eric Coombs, Oregon Department of Agriculture; Doris Tilles for assistance in obtaining theses on interlibrary loan; Olga N. Krankina for assistance in Russian translation; and Colleen MacRae for her thorough preparation of the manuscript. We thank the two reviewers for their comments and helpful suggestions.

Literature Cited

Barkworth, M. E. and D. R. Dewey. 1985. Genomically based genera in the perennial Triticeae of North America: Identification and membership. American Journal of Botany 72: 767–776.

Carvalho, J. C. M. 1958. Catalogo dos Mirideos do Mundo. Part III. Subfamilia Orthotylinae. Arquivos dos Museu Nacional, Rio de Janeiro, Brazil 47: 1–161.

Crawley, M. J. 1983. Herbivory: The dynamics of animal-plant interactions. University of California Press, Berkeley and Los Angeles. 437 pp.

Deitz, L. L. and L. M. Osegueda. 1989. Effectiveness of bibliographic data bases for retrieving entomological literature: A lesson based on the Membracoidea (Homoptera). Bulletin of the Entomological Society of America 35: 33–39.

Dewey, D. R. 1983. Historical and current taxonomic perspectives of *Agropyron, Elymus,* and related genera. Crop Science 23: 637–642.

Dillman, A. C. 1946. The beginnings of crested wheatgrass in North America. Journal of the American Society of Agronomy 38: 238–250.

Henry, T. J. and A. G. Wheeler, Jr. 1988. Miridae, pp. 251–507. *In* Henry, T. J. and R. C. Froeschner, eds., Catalog of the Heteroptera, or True Bugs, of Canada and the Continental United States. E. J. Brill, Leiden. 958 pp.

Kerzhner, I. M. 1973. True bugs (Heteroptera) fauna of Tchvinskoy AASR. Fauna of Siberia, Part 2. Academy of Science SSSR, Trudy 16: 78–91 (in Russian).

———. 1988. Miridae, pp. 778–857. *In* Ler, P. A., ed., Guide to the Insects of the Far East of the USSR. Volume II. Academy of Science of the USSR, Leningrad. 972 pp. (in Russian).

Kogan, M. and J. D. Lattin. 1993. Insect conservation and pest management. Biodiversity and Conservation 2: 242–257.

Kulik, S. A. 1965. Blindwansen Ost Sibiriens und des Fernen Ostens. (Heteroptera: Miridae). Acta Faunistica Entomologica Musei Nationalis Pragae 11(98): 39–69 (in Russian with German summary).

Lauenroth, W. K. 1979. Grassland primary production: North American grassland in perspective, pp. 3–24. *In* N. R. French, ed., Perspectives in Grassland Ecology. Springer-Verlag, New York. 204 pp.

Levin, D. A. 1973. The role of trichomes in plant defense. Quarterly Review of Biology 48: 3–15.

Ling, Y. H., W. F. Campbell, B. A. Haws, and K. H. Asay. 1985. Scanning electron microscope (SEM) studies of morphology of range grasses in relation to feeding by *Labops hesperius*. Crop Science 25: 327–332.

Love, L. D. and H. C. Hanson. 1932. Life history and habits of crested wheatgrass. Journal of Agricultural Research 45: 371–383.

Perry, E. 1954. New ranges for old. Western Livestock Journal 32 (July, 1954): 26–27, 39.

Rogler, G. A. and R. J. Lorenz. 1983. Crested wheatgrass—early history in the United States. Journal of Range Management 36: 91–93.

Schwartz, M. D. 1984. A revision of the black grass bug genus *Irbisia* Reuter (Heteroptera: Miridae). Journal of the New York Entomological Society 92: 193–306.

Spangler, S. M. and J. A. MacMahon. 1990. Arthopod faunas of monocultures and polycultures in reseeded rangelands. Environment Entomology 19: 244–250.

Turner, B. L. II and W. Meyer. 1992. Science capsule. Office for Interdisciplinary Earth Studies, Earthquest, Summer 1992. 4 pp.

Vinokurov, N. N. 1979. Identification manual of the fauna of the USSR. No. 123. Heteroptera of the Yakutia. Zoological Institute of the USSR, Leningrad. 232 pp. (in Russian).

Watts, J. G., E. W. Huddleston, and J. C. Owens. 1982. Rangeland entomology. Annual Review of Entomology 27: 283–311.

Wheeler, A. G., Jr. and T. J. Henry. 1992. A synthesis of Holarctic Miridae (Heteroptera): Distribution, biology, and origin, with emphasis on North America. Entomological Society of America, Thomas Say Foundation. No. 15. 306 pp.

Annotated Bibliography

This bibliography is an annotated list of publications and reports describing the biology and documenting the occurrence of native black grass bugs on introduced crested wheatgrasses and other plants in North America. The time period covered concludes with December, 1993.

The list began with an early effort some years ago to bring together the literature on native black grass bugs. This early list was subsequently further developed by a comprehensive search of several bibliographic sources, either in print, CD-ROM, or online format. These sources included AGRICOLA, Bibliography of Agriculture, Biological Abstracts, Biological and Agricultural Index (formerly Agricultural Index), CAB Abstracts, Dissertation Abstracts, Index to the Literature of American Economic Entomology, Review of Agricultural Entomology (formerly Review of Applied Entomology Series A. Agricultural), and Zoological Record. All sources were searched from their beginning publication date. The need to search a variety of bibliographic sources to uncover entomological literature has been discussed by Deitz and Osegueda (1989).

The list of references cited in each article or report located in the literature search was checked to identify additional publications that were relevant to the scope of the bibliography. Several theses were located in the process which are included in the bibliography for completeness, but they have not been annotated.

Scientific names which are no longer valid have been corrected to conform with current taxonomic use.

Akingbohungbe, A. E., J. L. Libby, and R. D. Shenefelt. 1972. Miridae of Wisconsin (Hemiptera: Heteroptera). University of Wisconsin, College of Agriculture and Life Sciences, Research Division. R. 2396. 24 pp. [*Labops hirtus* and *L. burmeisteri* were reported from Wisconsin. The genus *Labops* was included in a key to the genera of Wisconsin Miridae.]

Akingbohungbe, A. E., J. L. Libby, and R. D. Shenefelt. 1973. Nymphs of Wisconsin Miridae, Hemip-

tera: Heteroptera. University of Wisconsin, College of Agriculture and Life Sciences, Research Division. R. 2561. 25 pp. [The nymph of *Labops hirtus* is characterized. A diagnostic key to the nymphs of Wisconsin Miridae includes *Labops*.

Akingbohungbe, A. E. 1974. Nymphal characters and higher classification analysis in the Miridae (Hemiptera: Heteroptera) with a subfamily key based on the nymphs. Canadian Entomologist 106: 687–694. [The genus *Labops* was included in a study on dorsal abdominal gland openings in the mirid nymphs. The opening is simple and has a sclerotized bar, a character shared by most of the Orthotylinae included in the study.]

Anonymous. 1953. Outbreaks and new records. FAO Plant Protection Bulletin 2: 43–45. Rome. [*Irbisia brachycera* is reported (as *I. arcuata*) on *Agropyron intermedium* at the Experimental Station, Lethbridge, Alberta.]

Anonymous. 1966. Wheatgrass bugs (*Labops* spp.). United States Department of Agriculture, Agricultural Research Service, Plant Protection Quarantine, Cooperative Economic Insect Report 16: 623–624. [The economic importance of *Labops hesperius* and *L. hirtus* in western United States is reviewed. Crested and intermediate wheatgrasses were injured along with other grasses. Life history, habits, distribution, and a description of *L. hesperius* are given. A guide to detecting bug damage to grasses is included.]

Anonymous. 1977. Putting the stops on *Labops*. Oregon's Agricultural Progress. 21: 11–12. [The habits and damage caused by black grass bugs (*Labops hesperius*) in Oregon are reviewed.]

Ansley, R. J., Jr. 1979. The influence of black grass bugs (*Labops hesperius*) and cattle on the vigor of crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.). M.S. thesis, Utah State University, Logan. 84 pp.

Ansley, R. J. and C. M. McKell. 1982. Crested wheatgrass vigor as affected by black grass bug and cattle grazing. Journal of Range Management 35: 586–590. [Light to moderate populations (50–200 per m^2) of black grass bugs (*Labops hesperius*) appeared to reduce plant vigor in a seeded monoculture of crested wheatgrass in Utah. Combined grazing by cattle and black grass bugs resulted in greater reduction in vigor than by the insects alone.]

Araya, J. E. 1982. Studies of selected predators of black grass bugs (*Labops hesperius* Uhler and *Irbisia brachycera* Uhler) on ranges of Utah. M.S. thesis, Utah State University, Logan. 102 pp.

Araya, J. E. and B. A. Haws. 1988. Arthropod predation of black grass bugs (Hemiptera: Miridae) in Utah ranges. Journal of Range Management 41: 100–103. [Two species of Nabidae, *Nabis alternatus* Parshley and *N. vanduzeei* Kirkaldy, were found to be effective predators on black grass bugs with prey size scaled to predator size. Six species of spiders were also found to feed on the bugs: *Xysticus cunctator* Thorell, *Misumenops lepidus* (Thorell), *M. celer* (Hentz), *Tibellus* sp., *Castianeira* sp., and *Tetragnatha* sp.]

Araya, J. E. and B. A. Haws. 1991. Arthropod populations associated with a grassland infested by black grass bugs, *Labops hesperius* and *Irbisia brachycera* (Hemiptera: Miridae), in Utah, U.S.A. FAO Plant Protection Bulletin 39: 75–81. [*Nabis alternatus* and *N. vanduzeei* were reported to be important predators of *Labops hesperius* and *Irbisia brachycera*. A number of spiders were also recorded as predators of these two plant bugs including: *Xysticus cunctator, Misumenops lepidus, M. celer, Tibellus* sp., *Castianeira* sp., *Tetragnatha* sp., and *Metepeira foxi* Gertsch & Ivie. The value of these generalist predators is discussed. The authors suggest diversifying the plant species in the rangeland as a means of reducing the bugs' impact.]

Armitage, H. M. 1952. Current insect notes. State of California, Department of Agriculture. Bulletin 41: 180–183. [*Labops hesperius* is reported on crested wheat and smooth brome grass from Plumus County, California.]

Arnott, D. A. and I. Bergis. 1967. Causal agents of silver top and other types of damage to grass seed crops. Canadian Entomologist 99: 660–670. [The damage caused by different organisms that might result in silver top is reviewed. Miridae were included, but *Irbisia* and *Labops* are not mentioned specifically.]

Babcock, J. M., L. K. Tanigoshi, E. A. Myhre, and R. S. Zack. 1993. Arthropods occurring on sweet white lupin and native lupins in southeastern Washington. Pan-Pacific Entomologist 69: 261–271. [*Labops hesperius* is reported from the native *Lupinus leucophyllus* Douglas in southeastern Washington. The bugs were found on the plants towards the end of May and remained until the plants dried out; they were not found on white lupine (*Lupinus albus* L.), a non-indigenous species grown as a rotational crop in the area.]

Banks, N. 1910. Catalogue of the Nearctic Hemiptera-Heteroptera. American Entomological Society, Philadelphia. 103 pp. [The catalog lists early state records for *Irbisia brachycera, I. pacifica,* and *I. sericans,* and *Labops hesperius.* (For more recent information on distribution, see Schwartz 1984, Henry and Wheeler 1988.) (Note: *I. gilvipes* is now placed in the genus *Mecomma* Fieber.)]

Blatchley, W. S. 1926. Heteroptera or True Bugs of Eastern North America. Nature Publishing Company, Indianapolis. 1116 pp. [*Labops hesperius* and *L. burmeisteri* are treated. Each species is de-

scribed briefly and distribution records given. Blatchley states that he considers *L. hirtus* a synonym of *L. hesperius.*]

Blatchley, W. S. 1928. "Quit-Claim" specialist vs. the making of manuals. Bulletin of the Brooklyn Entomological Society 23: 10–18. [The identity of *Labops hesperius* is noted.]

Blatchley, W. S. 1934. Notes on a collection of Heteroptera taken in winter in the vicinity of Los Angeles, California. Transactions of the American Entomological Society 60: 1–16. [*Irbisia cuneomaculata* is described from Sunland, California. *Irbisia californica* was common in February and March on grasses and herbs.]

Bliven, B. P. 1961. New species of *Irbisia* from California. Occidental Entomologist 1: 45–49. [Six species of *Irbisia* are described as new: *I. eurekae, I. paenulata, I. vestifica, I. gorgoniensis, I. tejonica,* and *I. silvosa,* all from California. (See Schwartz 1984 for synonymy.)]

Bliven, B. P. 1963. New species of *Irbisia* from California II. Occidental Entomologist 1: 68–86. [Thirteen species of *Irbisia* are described as new, 12 from California and one from Arizona. Those described from California include: *I. umbratica, I. upupa, I. retrusa, I. incomperta, I. neptis, I. paulula, I. lacertosa, I. panda, I. limata, I. ustricula, I. inurbana,* and *I. serrata. Irbisia oreas* is described from Arizona. (See Schwartz 1984 for synonymy.)]

Bohning, J. W. and W. F. Currier. 1967. Does your range have wheatgrass bugs? Journal of Range Management 20: 265–267. [*Labops hesperius* damaged crested wheatgrass throughout much of western North America. Some basic biological information is included. The question was raised as to whether this was a native insect species (it is—J.D.L.). Although 900 acres were sprayed with malathion in the Santa Fe National Forest in 1967, the bugs returned the following year.]

Bowers, D. M. 1976. Insect consumption of seeded rangeland herbage in a selected area of Diamond Fork Canyon, Utah County, Utah. M.S. thesis, Utah State University, Logan. 45 pp.

Bowers, D. M. and B. A. Haws. 1977. Impact of insect consumption of rangeland forage in Utah. Society of Range Management, 30th Annual Meeting, Abstract, p. 35. [Insects consumed 34% (2.8 AUM) of the total available forage of a study area seeded to crested wheatgrass in Utah County, Utah. Cattle consumed 28% (2.1 AUM) at the same site. These comparative figures were used to calculate losses from insects.]

Brewer, P. S., W. F. Campbell, and B A. Haws. 1979. How black grass bugs operate. Utah Science 40: 21–23. [The method of feeding by *Labops hesperius* is described. Photographs and photomicrographs of the bug and damage are included. Intermediate wheatgrass and Kentucky bluegrass were more attractive to the bugs than crested wheatgrass.]

Burkhardt, C. C. 1974. Grass bug control in grass and wheat. University of Wyoming. Agricultural Experiment Station. Research Journal No. 82. 2 pp. [Damage to crested wheatgrass in eastern Wyoming by *Labops hesperius* is reported with bug densities reaching 100 per ft^2. A number of different compounds were applied to research test plots of grasses and winter wheat. Good control was achieved with a variety of compounds but many did not yet have label approval.]

Burkhardt, C. C., J. M. Edwards, and L. E. Bennett. 1986. Chemical control of grass bugs on crested wheatgrass. University of Wyoming, Laramie. College of Agriculture. Annual Research and Extension Centers Progress Report No. 885. 170–172. [Seven insecticides were tested against *Labops hesperius* on crested wheatgrass in Wyoming; most gave 92–100% control on three and seven-day post treatment sampling.]

Burmeister, H. C. C. 1835. Handbuch der Entomologie. Tome 2, Abtheil 1: i–xii, 1–400. T. Enslin, Berlin. [This paper contains the original description of *Labops* based upon *L. diopsis* Burmeister [a junior synonym of *Capsus sahlbergi* Fallén, monotypic (Henry and Wheeler 1988)].]

Campbell, W. F., B. A. Haws, K. H. Asay, and J. D. Hansen. 1984. A review of black grass bug resistance in forage grasses. Journal of Range Management 37: 365–369. [Several mechanisms of resistance are discussed including trichome length, non-preference, tolerance, and antibiosis. The authors conclude that there is potential for breeding resistance to black grass bugs in range grasses.]

Carvalho, J. C. M. 1958. Catalogo dos Mirideos do Mundo. Parte III. Subfamilia Orthotylinae. Arquivos do Museu Nacional, Rio de Janeiro, Brazil 47: 1–161. [Eleven species of *Labops* are reported from throughout the world, included are *Labops brooksi, L. burmeisteri, L. chelifer, L. hesperius, L. hirtus, L. nigripes* Reuter, *L. sahlbergi* Fallén, *L. setosus* Reuter, *L. tumidifrons, L. utahensis,* and *L. verae.* Relevant literature is referenced and distribution given.]

Carvalho, J. C. M. 1959. Catalogo dos Mirideus do Mundo. Parte IV. Subfamilia Mirinae. Arquivos do Museu Nacional, Rio de Janeiro, Brazil 48: 1–385. [Fourteen species of *Irbisia* are reported from North America and the Soviet Far East: *Irbisia brachycera, I. californica, I. castanipes, I. cuneomaculata, I. elongata, I. fuscipubescens, I. mollipes, I. nigripes, I. pacifica, I. paeta,* and *I. sericans.* (For the most recent documentation, see Schwartz 1984.)]

Childs, L. 1914. Insect notes. California State Commission of Horticulture. Monthly Bulletin 3: 220. [*Irbisia brachycera* and *I. californica* (as *I. serican,* see Schwartz 1984, p. 234) are reported feeding on grain at Stanford University, causing considerable damage.]

Cockerell, T. D. A. 1893. The entomology of the mid-alpine zone of Custer County, Colorado. Transactions of the American Entomological Society 20: 305–370. [The biogeography of the region and the impact of the topography, vegetation, and habitats on the insect fauna are discussed. *Irbisia brachycera* is reported from Westcliff, Colorado (as *Capsus brachycorus* (sic!) Uhler).]

Cockerell, T. D. A. 1910. Some insects from Steamboat Springs, Colo. II. Canadian Entomologist 42: 366–370. [*Irbisia brachycera* is reported from Steamboat Springs, Colorado.]

Coombs, E. M. 1985. Growth and development of the black grass bug (*Labops hesperius* Uhler) in the State of Utah. M.S. thesis, Utah State University, Logan. 163 pp.

Denning, D. G. 1948. The crested wheat bug. University of Wyoming, Agricultural Experiment Station. Circular No. 33. 2 pp. [*Labops hesperius* is reported damaging crested wheatgrass in Wyoming and affecting the palatability of the damaged hay to cattle.]

Dickerson, G. W. 1978. Control of black grass bugs (*Labops hesperius* Uhler) in northern New Mexico. Journal of Range Management 31: 398–399. [Trichlorfon, malathion, and methylparathion were used to control *Labops hesperius* in improved wheatgrass pastures. All provided good control; untreated plots showed up to a 50% reduction in herbage yields.]

Dillman, A. C. 1946. The beginnings of crested wheatgrass in North America. Journal of the American Society of Agronomy 38: 237–250. [The introduction of crested wheatgrass, *Agropyron cristatum,* into North America from Siberia, including sites of original plantings from the early seed importation, is reviewed in detail.]

Downes, W. 1924. New records of Hemiptera from British Columbia. Proceedings of the Entomological Society of British Columbia 21: 27–33. [*Labops hirtus* is reported from Chilcotin, British Columbia.]

Downes, W. 1927. A preliminary list of the Heteroptera and Homoptera of British Columbia. Proceedings of the Entomological Society of British Columbia 23: 1–22. [*Irbisia nigripes, I. brachycera* var. *solani* (probably *I. serrata*), and *I. sericans, I. pacifica* (as *Thyrillus pacificus*), *Labops hirtus, L. tumidifrons,* and *L. burmeisteri* are reported from British Columbia, Canada.]

Drake, C. J. 1922. Heteroptera in the vicinity of Cranberry Lake. Syracuse University, New York State College of Forestry, Technical Publication No. 16: 54–86. [*Labops hirtus* is reported from New York, including both short- and long-winged forms.]

Essig, E. O. 1915. Injurious and beneficial insects of California (Second edition). California State Commission of Horticulture. The Monthly Bulletin. Supplement 4. 541 pp. [*Irbisia brachycera,* reported as the black plant-bug, is a common insect in California attacking many cultivated crops and native plants. *Irbisia californica* (see Schwartz 1989, p. 263), reported as *Irbisia sericans,* the lesser black plant-bug, damaged barley, oats and wheat as well as other plants. *Irbisia pacifica,* reported as the pacific plant-bug, fed on grasses and grains, including barley, oats, and wheat.]

Essig, E. O. 1926. Insects of Western North America. Macmillan Company, New York. 1035 pp. [Six species of *Irbisia* are included: *I. solani, I. brachycera, I. californica, I. mollipes, I. setosa,* and *I. sericans. Irbisia solani* was reported as moving into cultivated fields and gardens when the grasses dry up and attacking a wide variety of plants. *Irbisia californica* and *I. mollipes* attacked grasses and grains. *Irbisia pacifica* was reported from grasses and grain.]

Essig, E. O. and W. M. Hoskins. 1944. Insects and other pests attacking agricultural crops. University of California, Agricultural Extension Service. Circular 87 (revised). 197 pp. [The black grass bug, *Irbisia solani,* and the California plant bug, *I. californica,* attacked grain in California. *Irbisia* spp. also attacked peaches and nectarines.]

Fisher, E. M. and R. W. Every. 1969. Federal-State Cooperative Economic Insect Report. Oregon (week ending May 23, 1969). 1 p. [*Labops hesperius* adults damaged brome grass, intermediate wheatgrass, pubescent wheatgrass, and orchard grass in eastern Oregon. Most of the damaged grass was on soil bank land; some stands were as old as 10 years.]

Foster, R. N., R. T. Staten, E. Miller, J. A. Henderson, J. B. Thernley, D. K. Sato, E. W. Huddleston, and R. G. Bullard. 1981. Malathion for control of black grass bugs. Insecticide and Acaricide Tests 6: 135–136. [Malathion (ULV) was applied at different concentrations on replicated 40 acre plots in New Mexico for control of *Labops hesperius* and *L. hirtus* on *Agropyron desertorum* (Fisch.) Schulten 1978. All treatments were highly successful.]

Fuxa, J. R. 1975. Biological attributes and alteration of the habitat to manipulate populations of *Labops hesperius* Uhler (Heteroptera: Miridae). M.S. thesis, Oregon State University, Corvallis. 118 pp.

Fuxa, J. R. and J. A. Kamm. 1976a. Effects of tem-

perature and photoperiod on the egg diapause of *Labops hesperius*. Environmental Entomology 5: 505–507. [*Labops hesperius* diapauses as a well-developed embryo, normally overwintering in that stage. At least 60 days exposure to 3° to 9° C plus approximately 14 days incubation at 15° C are required for hatching to occur. No hatching occurred if the chilling occurred in August. Approximately 40% hatching occurred if the chilling was delayed until September or later. The combination of increasing temperatures and day length in early spring appears to regulate egg hatch, allowing the eggs to hatch at relatively cold temperatures, an ideal adaptation to early herbage growth of host grasses.]

Fuxa, J. R. and J. A. Kamm. 1976b. Dispersal of *Labops hesperius* on rangeland. Annals of the Entomological Society of America 69: 891–893. [The adult population of *Labops hesperius* was analyzed at Vale, Oregon, in 1974; 43% were macropterous males, 53% brachypterous females, and only 4% macropterous females. Apparently the ovaries of macropterous females do not mature until the adults have completed their migratory phase of about three weeks. Dispersal capabilities were considered to be limited because of the high percentage of brachypterous females in the population. There was a positive correlation between old growth wheatgrass and bug density.]

Gates, D. H. 1969a. ABC (another bug on crested)-problem. Oregon State University. United States Department of Agriculture, and Oregon Counties Cooperating. The Grazier. No. 127: 3. [*Labops hesperius* and *Irbisia* spp. are reported damaging wheatgrass in several localities in eastern Oregon.]

Gates, D. H. 1969b. Black grass bug observations in Utah. Oregon State University, United States Department of Agriculture, and Oregon Counties Cooperating. The Grazier. No. 127: 5–6. [This report, taken from the Cooperative Economic Insect Report 16(25): 596, 1966, Plant Pest Control Division, Agricultural Research Service, United States Department of Agriculture, reviews several species of black grass bugs found in Utah: *Irbisia brachycera, Irbisia* spp., *Labops hesperius, L. hirtus,* and *L. utahensis.* Damage was reported on planted crested wheatgrass, intermediate wheatgrass, other wheatgrasses and miscellaneous grass species. *Labops* spp. caused more damage at higher elevations and *Irbisia* spp. at lower elevations. Barley was attacked in Sanpete County by *Irbisia* spp., as was rye in many areas of Utah. Seed damage to crested and intermediate wheatgrass was also common. It was felt that summer rains would result in additional grass growth, reducing the impact of the bugs' feeding.]

Gates, D. H. 1969c. Wheatgrass bugs (*Labops* spp.). Oregon State University, United States Department of Agriculture, and Oregon Counties Cooperating. The Grazier. No. 127: 4–5. [This report was abstracted from the Cooperative Economic Insect Report, Plant Pest Control Division, Agricultural Research Service, United States Department of Agriculture. General economic importance of these bugs is reported from western United States where damage to crested and intermediate wheatgrass occurred. Distribution information by state and province (Canada) is given. Life history information is given and the bug briefly described.]

Gibson, A. 1910. The entomological record, 1909. Entomological Society of Ontario, Fortieth Annual Report: 110–128. [*Labops burmeisteri* is reported from Ontario, Canada; this is the first published record of this native species in North America.]

Gibson, A. 1913. The entomological record, 1912. Entomological Society of Ontario, Forty-third Annual Report: 113–140. [*Irbisia brachycera* and *I. sericans* are reported from the Queen Charlotte Islands, Canada.]

Gillette, C. P. and C. F. Baker. 1895. A preliminary list of the Hemiptera of Colorado. (Colorado) State Agricultural College, Agricultural Experiment Station, Bulletin No. 31, Technical Series No. 1. 137 pp. [*Labops hesperius* is reported from several localities in Colorado. *Irbisia brachycera* and *I. pacifica* are also reported (as *Thyrillus brachycerus* and *T. pacificus*).]

Gray, A. M. 1975. Nutritional quality and herbage production of intermediate wheatgrass (*Agropyron intermedium* (Host) Brauv.) when infested with black grass bugs (*Labops hesperius* Uhler). M.S. thesis, Utah State University, Logan. 42 pp.

Hagen, A. F. 1976. Crested wheatgrass, *L. hesperius* control, 1975. Insecticide and Acaricide Tests 1: 102. [Several different chemicals, together with a control, were applied to plots in Scotts Bluff County, Nebraska. All treatments gave highly effective results.]

Hagen, A. F. 1982. *Labops hesperius* (Hemiptera: Miridae) management in crested wheatgrass by haying: An eight-year study. Journal of Economic Entomology 75: 706–707. [Annual harvest of a crested wheatgrass field significantly reduced the populations of *Labops hesperius* compared to a similar field that was not harvested.]

Hall, I. M. 1959. The fungus *Entomophthora erupta* (Dustan) attacking the black grass bug, *Irbisia solani* (Heidemann) (Hemiptera, Miridae), in California. Journal of Insect Pathology 1: 48–51. [This fungus caused an epizootic at Riverside, California. The fungus was previously known only from the mirids *Lygus communis* var. *novascotiensis*

Knight and *Plagiognathus* sp. Illustrations of the infected *Irbisia* are included together with a general description of the appearance of infected bugs.]

Hansen, J. D. 1986. Differential feeding on range grass seedlings by *Irbisia pacifica* (Hemiptera: Miridae). Journal of the Kansas Entomological Society 59: 199–203. [Eighteen range grasses were tested for feeding preference by *I. pacifica*. *Leymus cinereus* (Scrib. & Merr.) Love was the species most preferred and *Psathyrostachys juncea* (Fisch.) Nevski and *Agropyron fragile* (Roth) Candargy, the least preferred.]

Hansen, J. D. 1987. Feeding site selection by *Irbisia pacifica* (Hemiptera: Miridae) on four cool-season western range grasses. Journal of the Kansas Entomological Society 60: 316–323. [Feeding sites by *I. pacifica* were examined on Great Basin wildrye, *Leymus cinereus* (Scrib. & Merr.) Love, a crested wheatgrass hybrid and a hybrid between quack grass and blue bunch wheatgrass. Feeding density was greatest at the leaf apex and least at the base.]

Hansen, J. D. 1988. Field observations of *Irbisia pacifica* (Hemiptera: Miridae): Feeding behavior and effects on host plant growth. Great Basin Naturalist 48: 68–74. [The interaction of *I. pacifica* with intermediate wheatgrass, *Thinopyrum intermedium* (Host) Barkw. and D. R. Dewey, was examined in northern Utah. Egg hatch began in April; ovarian development was completed by mid-June. The second and third leaves were the preferred feeding sites.]

Hansen, J. D., K. H. Asay, and D. C. Nielson. 1985a. Screening range grasses for resistance to black grass bugs *Labops hesperius* and *Irbisia pacifica* (Hemiptera: Miridae). Journal of Range Management 38: 254–257. [Three crested wheatgrasses and two hybrids between quack grass and blue bunch wheatgrass were tested for resistance to feeding by these mirids. No difference in feeding preferences was noted. Tolerance is suggested as a possible mechanism of resistance.]

Hansen, J. D., K. H. Asay, and D. C. Nielson. 1985b. Feeding preference of a black grass bug, *Labops hesperius* (Hemiptera: Miridae), for 16 range grasses. Journal of the Kansas Entomological Society 58: 356–359. [Sixteen grass species and hybrids were tested for feeding preference by *L. hesperius*. *Dactylis glomerata* L., *Phalaris arundinacea* L. and *Pascopyrum smithii* (Rydb.) Love were among the least preferred and crested and intermediate wheatgrasses the most preferred.]

Hansen, J. D. and R. S. Nowak. 1988. Feeding damage by *Irbisia pacifica* (Hemiptera: Miridae): Effects of feeding and drought on host plant growth. Annals of the Entomological Society of America 81: 599–604. [Green leaf area per tiller was reduced by two-thirds in intermediate wheatgrass, for Great Basin wildrye (GBWR), the reduction was one-half. Drought conditions further reduced green leaf area on bug-infested GBWR but did not damage the previously affected intermediate wheatgrass.]

Hardee, D. D., H. Y. Forsythe, Jr., and G. G. Gyrisco. 1963. A survey of the Hemiptera and Homoptera infesting grasses (Gramineae) in New York. Journal of Economic Entomology 56: 555–559. [*Labops hirtus* is recorded from grass fields in New York.]

Harling, J., J. M. Snyder, and D. M. Coletti. 1977. Insects collected from an alpine-sub alpine region in southeast British Columbia. Journal of the Entomological Society of British Columbia 74: 34–36. [*Irbisia nigripes* is reported from the Selkirk Mountains in southeastern British Columbia, Canada.]

Harrington, W. H. 1892. Fauna Ottawaensis, Hemiptera. Ottawa Naturalist 6: 25–32. [*Labops hesperius* is reported from the vicinity of Ottawa, Canada, and the long-winged form noted as rare.]

Haws, B. A. 1972. Preliminary report on black grass bug *Labops hesperius* Uhler. United States Department of Agriculture, Forest Service, Inter Mountain Region, Range Improvement Notes 17: 1–3. [The Black Grass Bug project at Utah State University was established in 1971. Full observations on the bug showed early seasonal growth of range grasses and concomitant development of early instar bugs, which were active at low air temperatures (22° F). There was evidence that considerable damage to the grass by bugs occurred early in the season.]

Haws, B. A. (Compiler). 1978. Economic impacts of *Labops hesperius* on the production of high quality range grasses. Utah State University, Agricultural Experiment Station. Final Report to Four Corners Regional Commission. 267 pp. [The environmental impact of *L. hesperius*, upon range grasses, chiefly crested and intermediate wheatgrass, is discussed. Other arthropods, including some natural enemies of *L. hesperius*, are reported.]

Haws, B. A. 1979. Something is eating more grass that our livestock. Rangelands 1: 135–138. [This popular account of range insects includes several references to *Labops hesperius* and its damage to grasses.]

Haws, B. A. (Compiler). 1982a. An introduction to beneficial and injurious rangeland insects of the western United States. Utah State University, Utah Agriculture Experiment Station. Special Report 23. 64 pp. [This general introduction to the insects found on western rangeland includes many photographs of *Labops hesperius* and *Irbisia pacifica* and their damage. The role of *L. hesperius* as a rangeland pest is discussed.]

Haws, B. A. (Compiler). 1982b. Rangeland improvement; Demonstration Project. FCRC No. 602-466-080-4. Final Report of Five States to the Four Corners Regional Commission (Arizona, Colorado, Nevada, New Mexico, Utah). Utah State University, Logan. 282 pp. [A summary of cooperative work involving Nevada, Utah, Colorado, New Mexico and Arizona on *Labops hesperius, L. hirtus, L. utahensis, Irbisia brachycera* and *I. pacifica* is included. Plantings of crested wheatgrass along highways were suggested to provide "bug freeways" for dispersal of the insects.]

Haws, B. A. 1986. The status of IPM strategies for controlling grass bugs infesting introduced grassland monocultures, pp. 67–72. *In* Onsager, J. A., ed., Integrated Pest Management on Rangeland. United States Department of Agriculture, Agricultural Research Service. ARS-50. [Strategies for managing grass bugs include chemical control, plant resistance, burning, grazing, planting heterocultures, and biological control. Future work on reducing the grass monocultures is suggested.]

Haws, B. A. and G. E. Bohart. 1986. Black grass bugs (*Labops hesperius* Uhler) (Hemiptera: Miridae) and other insects in relation to crested wheatgrass, pp. 123–145. *In* Johnson, K. L., ed., Crested Wheatgrass: Its Values, Problems and Myths: Symposium Proceedings. Utah State University, Logan. [The insects, native and introduced, range grasses, and the problems of management strategies to minimize the impact of insect damage are reviewed. Basic biology of the bugs is compared to phenology of the wheatgrass. Many possible control strategies are discussed.]

Haws, B. A., D. D. Dwyer, and M. G. Anderson. 1973. Problems with range grasses? Look for black grass bugs! Utah Science 34: 3–9. [Information on the recognition, distribution, life history of *Irbisia pacifica, Labops hesperius, L. hirtus,* and *L. utahensis,* their damage, and management and control is included.]

Haws, B. A., C. M. McKell, and J. Malechek. 1976. Do insects affect the validity of basic assumptions of grazing management? Society for Range Management, 29th Annual Meeting, Abstract, p. 28. [Some reproductive structures of crested wheatgrass developed despite a heavy concentration *Labops hesperius* (900 per sweep). Undergrazed ranges had heavier bug infestations because of increased dead grass and plant debris, which provided sites for egg deposition.]

Hayward, C. L. 1948. Biotic communities of the Wasatch chaparral, Utah. Ecological Monographs 18: 473–506. [*Irbisia brachycerus* is reported from the herb layer of the lower chaparral of the Wasatch Mountains, Utah.]

Heidemann, O. 1900. Papers from the Harriman Alaska Expedition. XIII. Entomological Results (7): Heteroptera. Proceedings of the Washington Academy of Sciences 2: 503–506. [*Irbisia sericans,* originally described from Sitka, Alaska, is recorded from eight locations in Alaska during June and July in both macropterous and brachypterous forms. A collection record from near Hood River, Oregon, is included.]

Heidemann, O. 1910. Description of a new capsid. Proceedings of the Entomological Society of Washington 12: 200–201. [*Irbisia solani* is described (as *Capsus solani*) from Walnut Creek, California, with other specimens from California, Washington, and Utah. It was found on *Lupinus* sp. in California and injured potato plants.]

Henry, T. J. and A. G. Wheeler, Jr. 1988. Miridae, pp. 25–507. *In* Henry, T. J., and R. C. Foreschner, eds., Catalog of the Heteroptera, or True Bugs, of Canada and the Continental United States. E. J. Brill, Leiden. 958 pp. [Twenty-three species of *Irbisia* are included. Only a single species, *I. sericans,* extends from the Pacific Northwest into eastern Asia. Eight species of *Labops* are cataloged, including *L. burmeisteri,* a species known to occur in northern North America and west into the eastern Palearctic Region.]

Herms, W. B. 1926. An analysis of California's major entomological problems. Journal of Economic Entomology 19: 262–270. [*Irbisia solani* migrated from grass as it dried to feed on the California buckeye, *Aesculus californica* Nuttall. Droplets of plant sap exuding from the punctures made by the bugs were fed upon by bees.]

Hewitt, G. B. 1975. Grass bugs may be present on your rangeland. Society for Range Management, International Mountain Section, Newsletter No. 1: 3. [This brief review of the presence of *Labops* and *Irbisia* on range grasses and grain includes a history of their occurrence and effect upon the vegetation. A chemical control method is cited from the publication by C. C. Burkhardt (1974).]

Hewitt, G. B. 1980. Tolerance of ten species of *Agropyron* to feeding by *Labops hesperius.* Journal of Economic Entomology 73: 779–782. [Cultivars of ten different species and varieties of the wheatgrasses, *Agropyron* spp., were screened for feeding tolerance to *L. hesperius* and *Capsus simulans* Stål at Bozeman, Montana. Infested and non infested plants were compared for number of culms per plant, percentage of abnormal seed heads, seed production, seed weight, seed germination, forage production, and percentage leaf damage. Feeding reduced the number and weight of seeds, and the percentage of germination of most grass species. Silver top was recorded only in infested cages. Tall, slender, intermediate, and pubescent wheatgrasses appeared somewhat tolerant to grass bug feeding;

however, grass bugs preferred introduced wheatgrasses over native vegetation.]

Hewitt, G. B. and W. H. Burleson. 1975. Arthropods associated with two crested wheatgrass pastures in central Montana. Journal of Range Management 28: 301–304. [Two crested wheatgrass (*Agropyron desertorum*) (Fisch.) Schult.) pastures were surveyed for arthropods in 1972 and 1973. Although it was expected both *Irbisia* spp. and *Labops* spp. would be abundant, only 21 specimens of *Irbisia* and no *Labops* were collected during the two-year study.]

Hewett, G. B. and W. H. Burleson. 1976. An inventory of arthropods from three rangeland sites in central Montana. Journal of Range Management 29: 232–237. [Three sites in central Montana were sampled in 1972 and 1973: a mountain, foothill, and plains rangeland. Seven orders of arthropods formed the bulk of the material collected. *Labops hesperius* was the second most abundant insect at the mountain site but was not collected at the other two sites; *L. brooksi* was taken in small numbers at the foothill site.]

Hewitt, G. B., E. W. Huddleston, R. J. Lavigne, D. N. Veckert, and J. G. Watts. 1974. Rangeland Entomology. Society for Range Management, Range Science Series No. 2. 127 pp. [This review of sucking insects of grasses and forbs in rangeland includes *Irbisia* spp. and *Labops* spp. and brief discussion of their damage, biology, and control.]

Higgins, K. M. 1975. The effects of the black grass bug *Labops hesperius* Uhler, on several native and introduced grasses. M.S. thesis, Utah State University, Logan. 82 pp.

Higgins, K. M., J. E. Bowns, and B. A. Haws. 1977. The black grass bug (*Labops hesperius* Uhler): Its effect on several native and introduced grasses. Journal of Range Management 30: 380–384. [Six introduced grass species were more susceptible to damage by *L. hesperius* than native range grasses. Slender and intermediate wheatgrasses and Kentucky bluegrass were the most susceptible.]

Homan, H. W. 1977. *Labops* grass bug, *Labops utahensis*. University of Idaho, Cooperative Extension Service. Idaho's Insect Reporter, p. 33. [*Labops utahensis* caused minor damage to a grain field near Driggs, Idaho.]

Horning, D. S., Jr. and W. F. Barr. 1970. Insects of Craters of the Moon National Monument, Idaho. University of Idaho, College of Agriculture, Miscellaneous Series No. 8. 118 pp. [*Irbisia pacifica* is reported from this area.]

Jensen, F. 1971. Reseeding and *Labops*. United States Department of Agriculture, Forest Service, Inter Mountain Region. Range Improvement Notes 16: 6–9. [Severe damage to range grasses by *L. hesperius* is reported in Dixie National Forest, Utah, where the areas have been plowed or otherwise disturbed and then seeded with crested wheatgrass, intermediate wheatgrass, and smooth brome. Large numbers of *Labops* were found on giant wild ryegrass. Several treatments were used on the range prior to reseeding, plowing, cabling, and chaining. Pesticide control of *Labops* was ineffective; creation of a balanced plant community rather than a monoculture was recommended.]

Jensen, F. 1973. Reseeding and *Labops*. Society for Range Management, 26th Annual Meeting Abstract, p. 23. [*Labops hesperius* inhabits much of the reseeded rangelands on the Dixie National Forest, Utah. Population densities and resulting damage are related to plant community diversity. Densities were greatest in plowed rangelands that had been seeded to virtual monocultures of crested wheatgrass, intermediate wheatgrass, or smooth brome. Planting for a more diversified plant community is suggested, including the conservation of native grasses.]

Kamm, J. A. and J. R. Fuxa. 1977. Management practices to manipulate populations of the plant bug *Labops hesperius* Uhler. Journal of Range Management 30: 385–387. [Populations on wheatgrass increased with nitrogen fertilization; no response was shown to applications of phosphorus and potassium. Early curing of the herbage with paraquat, mechanical removal of the herbage, and heavy spring grazing all reduced bug populations in spring and summer. Grassbug survival is enhanced by pastures with adequate oviposition sites, winter protection, and habitat.]

Kamm, J. A. and R. R. Robinson. 1974. *Labops*, a plant bug, on Oregon rangeland. Oregon State University, Extension Service, Fact Sheet 211. 2 pp. [*Labops hesperius* is reported on native rangeland seeded with introduced wheatgrasses in eastern Oregon. Many different grasses, introduced and native, are recorded as host plants. The general life history is described. One hundred and twenty bugs per ft^2 reduced the nutritive value of intermediate wheatgrass by 18% midway in the growing season. This loss decreased to 23% if the rangeland was reserved for fall pasture. Greatest losses occur during severe summer drought.]

Kamm, J. A., F. A. Sneva, and L. M. Rittenhouse. 1978. Insect grazers on the cold desert biome. Proceedings of the First International Rangeland Congress, D. N. Hyder (ed.), Society for Range Management, Denver, Colorado, pp. 479–483. [Population levels of *Labops hesperius* increased in response to widespread planting of introduced wheatgrasses. Increased use of resistant grass varieties could have occurred if the pest potential of this bug had been recognized.]

Kelton, L. A. 1959. Male genitalia as taxonomic char-

acters in the Miridae (Hemiptera). Canadian Entomologist (Supplement 11) 91: 1–72. [This review of male genitalia structure in mirids includes *Irbisia pacifica, I. sericans, Labops hesperius, L. hirtus* and *L. sahlbergi.*]

Kelton, L. A. 1980. The insects and arachnids of Canada. Part 8. The plant bugs of the Prairie Provinces of Canada. Heteroptera: Miridae. Agriculture Canada. Publication 1703. 408 pp. [This review of the mirids of west-central Canada includes a brief description of each species with distribution maps and host information. Keys are given to allow identification of each species. Some species (*Labops hirtus*) are illustrated with habitus drawings. The genus *Irbisia* (pp. 83–86) includes the four species found in the Prairie Provinces (*I. brachycera, I. elongata, I. fuscipubescens,* and *I. nigripes*). The genus *Labops* (pp. 189–194) includes *L. brooksi, L. hesperius, L. hirtus, L. tumidifrons,* and *L. verae.*]

Kirkaldy, G. W. 1906. List of the genera of the pagiopodus Hemiptera-Heteroptera, with their type species, from 1758 to 1904 (and also of the aquatic and semi-aquatic Trochalopoda). Transactions of the American Entomological Society 32: 117–156. [This important paper lists the type species of the genera of several families, including *Irbisia* and *Labops.*]

Knight, H. H. 1918. Synoptic key to the subfamilies of Miridae (Hemiptera-Heteroptera). Journal of the New York Entomological Society 26: 40–44. [Details of the claw of *Labops hesperius* are illustrated.]

Knight, H. H. 1921. Scientific results of the Katmai expeditions of the National Geographic Society. XIV. Hemiptera of the family Miridae. Ohio Journal of Science 21: 107–112. [*Irbisia sericans* is reported from Katmai, Alaska, where it was abundant and feeding on rye grass. Described originally from Sitka, Alaska, it is the only species of *Irbisia* to occur in the Old World (Siberia).]

Knight, H. H. 1922. The North American species of *Labops* (Heteroptera-Miridae). Canadian Entomologist 54: 258–261. [Three species are considered: *L. hesperius, L. hirtus,* and *L. tumidifrons,* the latter two described as new. *Labops hirtus* is described from New York with other specimens from across northern United States and southern Canada. *Labops tumidifrons* is described from British Columbia, Canada. Some notes are included on the taxonomic value of the shape of the male clasper.]

Knight, H. H. 1923. Family Miridae (Capsidae), pp. 422–658. *In* Britton, W. E., ed., Guide to the Insects of Connecticut. Part IV. The Hemiptera or Sucking Insects of Connecticut. State of Connecticut, State Geological and Natural History Survey, Bulletin No. 34. 807 pp. [A brief description of *Labops hirtus* and state records from Maine, Massachusetts, and New York are given.]

Knight, H. H. 1925a. Descriptions of a new genus and eleven new species of North American Miridae (Hemiptera). Canadian Entomologist 57: 89–97. [*Irbisia nigripes* is described as new from Troy, Idaho, with additional specimens from Alberta, British Columbia, Canada, and Montana.]

Knight, H. H. 1925b. A list of Miridae and Anthocoridae from Alberta, Canada (Hemiptera). Canadian Entomologist 57: 181–182. [*Labops hesperius* is reported from Nordegg, Alberta, Canada, and *Irbisia nigripes* from Waterton Lakes in the same province.]

Knight, H. H. 1926. *Capsus simulans* (Stål) and *Labops burmeisteri* Stål recognized from the Nearctic Region. (Hemiptera, Miridae). Canadian Entomologist 58: 59–60. [*Labops burmeisteri* is reported from the Abitibi Region of northern Ontario, Canada. This species was described originally from Siberia. Although there had been earlier records of this species from North America, Knight was unable to locate any specimens.]

Knight, H. H. 1927. On the Miridae in Blatchley's "Heteroptera of Eastern North America." Bulletin of the Brooklyn Entomological Society 22: 98–105. [Blatchley's concept of *Labops hesperius,* which includes species variation associated with geographic distribution, is discussed.]

Knight, H. H. 1928. Family Miridae, pp. 110–134. *In* Leonard, M. D., ed., A List of the Insects of New York. Cornell University, Agricultural Experiment Station, Memoir 101. 1121 pp. [Localities of *Labops hirtus* for the state of New York are listed.]

Knight, H. H. 1929a. *Labops verae,* new species, with *Labopella, Nicholia* and *Pronotocrepis,* new genera of North American Miridae (Hemiptera). Canadian Entomologist 61: 214–218. [A new high-altitude, high-latitude species of *Labops, L. verae,* is described from Mt. Rainier, Washington, and Banff, Alberta.]

Knight, H. H. 1929b. Rectifications for Blatchley's "Heteroptera" with the description of a new species (Hemiptera). Bulletin of the Brooklyn Entomological Society 24: 143–154. [The identity of the *Labops* species treated by Blatchley (1926) is clarified.]

Knight, H. H. 1941a. New species of *Irbisia* Reuter (Hemiptera, Miridae). Bulletin of the Brooklyn Entomological Society 36: 75–79. [Three new species of *Irbisia* are described from western North America (*I. elongata, I. fuscipubescens* and *I. shulli*). Distributional information is included for each new species and for *I. brachycera.*]

Knight, H. H. 1941b. The plant bugs, or Miridae of

Illinois. Illinois Natural History Survey, Bulletin. Volume 22: 1–234. [No *Labops* species were reported from Illinois; *L. hirtus* is reported from Colorado, Maine, Massachusetts, Montana, New York, and Ontario, Canada.]

Knight, H. H. 1968. Taxonomic review: Miridae of the Nevada Test Site and the western United States. Brigham Young University, Science Bulletin, Biological Services 9: 1–282. [This review of mirids found in western United States includes descriptions of many new species and keys for the identification of many of the included species. Five species of *Irbisia* are briefly discussed and keyed (*I. brachycera, I. elongata, I. nigripes, I. pacifica,* and *I. shulli*). Information is largely restricted to collection localities. *Labops hesperius, L. hirtus,* and *L. utahensis* are listed with state distribution records only.]

Knight, J. B. 1982. An initial survey of the insects associated with five grassland sites in central Utah. M.S. thesis, Utah State University, Logan. 81 pp.

Knight, J. B. 1986. Range insects—pests and beneficials, pp. 73–75. *In* Onsager, J. A., ed., Integrated Pest Management on Rangeland. United States Department of Agriculture, Agricultural Research Service. ARS-50. [A brief review of the pest insects found on rangeland, including Homoptera, Hemiptera, Lepidoptera, Diptera and Hymenoptera, is followed by general remarks on biological control agents, chiefly of weeds.]

Knowlton, G. F. 1931. Notes on Utah Heteroptera and Homoptera. Entomological News 42: 68–72. [*Irbisia brachycerus* var. *solani* Heidemann and *I. pacifica* (as *Thyrillus pacificus*) are reported from several localities in Utah.]

Knowlton, G. F. 1932. Notes on Utah Hemiptera. Canadian Entomologist 64: 166–167. [*Labops hirtus* is reported from Providence, Utah.]

Knowlton, G. F. 1945. *Labops* damage to range grasses. Journal of Economic Entomology 38: 707–708. [*Labops tumidifrons* fed in large numbers on giant wild rye, *Elymus condensatus* Presl., in Utah. Other specimens were collected on bunch grass and large bunch grass at several sites in Utah and Idaho. *Labops hesperius* was collected on meadow grass and at several other localities in Utah on smooth broom. *Labops hirtus* was taken on range grasses in Utah and Idaho.]

Knowlton, G. F. 1951. Bugs damage grass in Utah. Bulletin of the Brooklyn Entomological Society 46: 74–75. [*Irbisia pacifica* (as *Thyrillus pacificus*) damaged giant rye grass Timothy, blue grass brome, and several other grasses in Morgan County, Utah. Other Hemiptera found on the grasses were *Labops hirtus* and *Slaterocoris atritibialis* (Knight) (as *Strongylocoris atritibialis*).]

Knowlton, G. F. 1955a. Hemiptera of Utah—records. Utah State Agricultural College, Extension Service, Mimeograph Series No. 140. 15 pp. [*Irbisia arcuata, I. brachycera, I. solani* and *Labops hesperius, L. hirtus,* and *L. utahensis* are reported from Utah.]

Knowlton, G. F. 1955b. Some Hemiptera and Homoptera of Utah—1955. Utah State Agricultural College, Extension Service, Mimeograph Service No. 145. 9 pp. [*Irbisia elongata* is reported from Utah.]

Knowlton, G. F. 1966a. Insect conditions in Utah—1966. Utah State University, Cooperative Extension, Entomology Mimeo Series No. 114. 4 pp. [Approximately 200,000 acres were damaged by *Labops hesperius, L. utahensis, Irbisia brachycera, I. shulli,* and *I. pacifica* in Utah during 1966.]

Knowlton, G. F. 1966b. Grass bugs, range and crop pests in Utah. Utah State University, Cooperative Extension, Entomology Mimeo Series No. 119. 5 pp. [This brief general discussion of the extent and range of damage to grasses and crops in Utah by mirids gives detailed distributional information for 15 species including *Labops hesperius, L. hirtus, L. utahensis, Irbisia brachycera, I. pacifica,* and *I. shulli.*]

Knowlton, G. F. 1967. Grass bugs: A serious range problem in 1966. Utah Academy of Sciences, Arts and Letters 43: 20–21. [Grass bugs extensively damaged crested wheatgrass, intermediate wheatgrass, giant rye grass, and other planted and native grasses in Utah. The species included *Irbisia brachycera, I. pacifica, I. shulli, Labops hesperius, L. utahensis, Leptopterna ferrugata* (Fallén), *Stenodema pilosipes* Kelton, *S. vicinum* (Provancher), and *Trigonotylus dohertyi* (Distant). At least 200,000 acres were damaged, especially at higher elevations. Wheat, barley, and rye were also damaged.]

Knowlton, G. F. 1973. Some Hemiptera of Curlew Valley. Utah State University, Terrestrial Arthropod Series No. 5. 8 pp. [A partial list of the Hemiptera of the Utah portion of Curlew Valley includes records of *Irbisia brachycera* on crested wheat and giant rye grasses and *I. brachycerus solani* (probably *I. serrata*) (no hosts given) and *I. pacifica* on crested wheatgrass and giant ryegrass. *Labops hesperius* was reported from crested wheatgrass at Cedar Creek, Utah.]

Knowlton, G. F. and F. C. Harmston. 1940. Utah insects. Hemiptera. Utah State College, Utah Agricultural Experiment Station, Mimeograph Series 200 (Technical). Part 5. 10 pp. [*Labops hesperius* and *L. hirtus* are reported from several localities in Utah as are *Irbisia brachycera, I. brachycera solani, I. mollipes, I. arcuata,* and *I. nigripes.*]

Kumar, R., R. J. Lavigne, J. E. Lloyd, and R. E. Pfadt. 1976. Insects of the Central Plains Experiment

Range, Pawnee National Grassland. University of Wyoming, Agricultural Experiment Station, Science Monograph 32. 74 pp. [*Labops hesperius* is reported from the Central Plains Experimental Range (Pawnee National Grasslands) in Colorado.]

La Follette, R. A. 1915. Preliminary list of common Heteroptera from the Claremont-Laguna region. Journal of Entomology and Zoology 7: 123–129. [*Irbisia politus* Uhler is reported from Claremont, California and nearby localities. (This must be a mistake; there is no combination, *Irbisia politus* Uhler, and one species is described as "very dark olive green, legs yellowish brown.")]

Lange, W. H., Jr. 1941. The artichoke plume moth and other pests injurious to the globe artichoke. University of California, Agricultural Experiment Station, Bulletin 653. 71 pp. [*Irbisia solani* is reported as damaging artichokes; the report is attributed to Tavernetti (1933).]

Larochelle, A. 1984. Les punaises terrestres (Hémiptères: Geocorises) du Québec. Fabreries, Supplement 3. 1–513. [*Irbisia sericans, Labops hesperius, L. hirtus,* and *L. burmeisteri* are reported from Quebec, Canada. An extensive bibliography on the hemipteran fauna of Quebec is included with keys for identification. (The record for *I. sericans* has not been duplicated (Schwartz 1984, p. 263).)]

Larochelle, A. and M. C. Lariviere. 1979. Le genre *Labops* Burmeister du Québec, Canada (Heteroptera: Miridae): Repartition geographique, habitat et biologie. Bulletin d'inventaire des insectes du Québec 1(4): 61–67. [This review of *Labops* spp. found in the province of Quebec, Canada, includes *Labops burmeisteri* and *L. hirtus. Labops hesperius,* reported from Quebec by early authors, is removed from the faunal list because no specimens could be located to document its occurrence.]

Leonard, M. D. (ed.). 1928. A list of the insects of New York. Cornell University, Agricultural Experiment Station. Memoir 101. 1121 pp. [*Labops hirtus* is reported from several localities in New York State.]

Lindsay, H. G. 1970. A serious threat: Black grass bugs. Utah Farmer. August 6, 1970, p. 12. [This article discusses black grass bugs in Utah, especially *Labops* spp. Details on life history, damage, and possible chemical control methods are given and the need for research on this problem is stated.]

Ling, Y. H. 1982. Scanning electron microscopic (SEM) studies on range grasses and their resistance to black grass bugs. M.S. thesis, Utah State University, Logan. 94 pp.

Ling, Y. H., W. F. Campbell, B. A. Haws, and K. H. Asay. 1985. Scanning electron microscope (SEM) studies of morphology of range grasses in relation to feeding by *Labops hesperius.* Crop Science 25: 327–332. [Selected grass varieties were subjected to similar bug densities in rearing chambers. Results suggested that selecting clones of wheatgrasses with large trichomes should confer some resistance to this insect.]

Loan, C. C. 1965. Life cycle and development of *Leiophron pallipes* Curtis (Hymenoptera: Braconidae: Euphorinae) in five mirid hosts in the Belleville district. Proceedings of the Entomological Society of Ontario 95: 115–121. [The braconid parasite *Leiophron pallipes* was reared from *Labops hirtus* near Belleville, Ontario, Canada. The parasite larva emerged from the adult bug and then pupated, spinning a silken cocoon. The adult wasp emerged the following year.]

Loan, C. C. 1980. Plant bug hosts (Heteroptera: Miridae) of some euphorine parasites (Hymenoptera: Braconidae) near Belleville, Ontario, Canada. Naturaliste Canadien 107: 87–93. [The braconid parasite *Peristenus pallipes* (Curtis) was reared from *Labops hirtus* collected near Belleville, Ontario, Canada, as well as from four other mirid species.]

Lockwood, S. 1933. Insect and mite scars of California fruits. California Department of Agriculture. Monthly Bulletin 22: 319–345. [*Irbisia solani* was suspected of causing scarring of peaches, especially in orchards close to grassy or weedy slopes. The bugs became very abundant in the orchards after the surrounding vegetation dried up.]

Lockwood, S. 1937. Farm sanitation aids pest control. California Cultivator 84: 537, 557. [Black grass bugs (no scientific name given) are reported as a pest of cultivated crops, especially peaches, moving to these plants as the grasses dried up.]

Lockwood, S. and E. T. Gammon. 1949. Incidence of insect pests. California Department of Agriculture. Bulletin 38: 190–203. [*Irbisia* sp. is reported cat-facing peaches, cherries, and plums in parts of Riverside County, California. DDT was used for control.]

MacGillivray, A. D. and C. O. Houghton. 1903. A list of insects taken in the Adirondack Mountains, N.Y.—III. Entomological News 14: 262–265. [*Labops hesperius* is reported from the Adirondack Mountains of New York.]

Malechek, J. C., A. M. Gray, and B. A. Haws. 1977. Yield and nutritional quality of intermediate wheatgrass infested by black grass bugs at low population densities. Journal of Range Management 30: 128–131. [Populations of *Labops hesperius* at 156 bugs per m^2 did not affect herbage yields of intermediate wheatgrass in Utah. Seed head production was reduced 56%, resulting in a slight in-

crease in crude protein and a small decrease in cell content.]

Markgraf, P. M. 1974. Effects of wheatgrass bug infestation on range grasses. Society for Range Management, 27th Annual Meeting. Abstract, p. 31. [*Labops hesperius* was studied on soil bank lands seeded to wheatgrasses in northeast Oregon. Feeding by mature nymphs and adults was heavy in May, reducing current annual growth of air-dry herbage by 13%. The quality of the resulting foliage was 5% less digestible. Although chemical control of the bugs is possible, resource management to reduce litter and straw accumulation was considered more economical.]

McAtee, W. L. 1923. Heteroptera. *In* A biological survey of the Pribilof Islands, Alaska, Part II. Insects, arachnids, and chilopods. North American Fauna No. 46. p. 145. [*Irbisia sericans* is reported from the St. Paul Island and St. George Island, Alaska, from June to September.]

McKendrick, J. D. and D. P. Bleicher. 1980. Observations of a grass bug on bluejoint ranges. Agroborealis 12: 15–18. [A native bluejoint reedgrass (*Calamagrostis canadensis* (Michx.) Beauv.) was damaged by *Irbisia sericans* near Homer, Alaska. The range of this bug includes parts of eastern Siberia and Alaska south to San Francisco, California. Evidence showed a negative correlation between insect damage and total nonstructural carbohydrates in the grass. The possibility of some resistance to insect damage because of silica in the grass was suggested. The bug was also reported from fireweed (*Epilobium angustifolium* L.).]

Mills, H. B. 1939. Montana insect pests for 1937 and 1938. Montana State College, Agricultural Experiment Station, Bulletin 366. 32 pp. [*Labops hesperius* and *Conostethus* n. sp. were found on range grasses and winter wheat at sites in Montana. The number of bugs declined in late May and the wheat outstripped the injury. The range grasses attacked were *Koeleria cristata* (L.) Pers., *Poa secunda* Presl., *Stipa comata* Trin. and Rupt., *Stipa williamsi* Scrbn., and an unidentified species.]

Mills, H. B. 1941. Montana insect pests 1939 and 1940. Montana State College, Agricultural Experiment Station, Bulletin 384. 28 pp. [*Labops hesperius* moved into wheat near Bozeman, Montana, causing mottling of the leaves.]

Moore, G. A. 1944. A list of Hemiptera taken at Hudson Heights, Quebec. Canadian Entomologist 76: 40–44. [*Labops hesperius* is reported from Hudson Heights, Quebec. (Note: This identification is doubtful, see Larochelle and Lariviere (1979).)]

Moore, G. A. 1950. Checklist of Hemiptera of the Province of Quebec. Naturaliste Canadien 77: 233–271. [*Labops hesperius* and *L. hirtus* are reported from Quebec; the record of *L. hesperius* is based on Van Duzee (1916c).]

Osborn, H. 1893. Notes on the distribution of Hemiptera. Proceedings of the Iowa Academy of Sciences 1: 120–123. [*Labops hesperius* is reported from New Hampshire. This record almost certainly refers to *L. hirtus*.]

Oshanin, B. 1912. Katalog der paläarktischen Hemipteren (Heteroptera, Homoptera-Auchenorhyncha-und Psylloideae). R. Friedlander and Sohn, Berlin. 187 pp. [This catalog of the Old World Hemiptera includes the Heteroptera and part of the Homoptera. *Irbisia sericans* is reported from northern Siberia and the Neartic Region. Four species of *Labops* are included: *L. setosus* from Siberia; *L. sahlbergi* from Scandinavia, northern and middle Russia and Siberia; *L. burmeisteri* from Siberia; and *L. nigripes* from Siberia and Mongolia. (*Labops burmeisteri* is also found in North America.)]

Osman, D. H. 1979. The toxicity, metabolism and distribution of carbaryl in three species of *Labops* with and without piperonyl butoxide treatment (Hemiptera: Miridae). M.S. thesis, Utah State University, Logan. 85 pp.

Osman, D. H. and W. A. Brindley. 1981. Estimating monooxygenase detoxification in field populations: Toxicity and distribution of carbaryl in three species of *Labops* grass bugs. Environmental Entomology 10: 676–680. [In tests of monooxygenase detoxification of carbaryl by field populations of *Labops hesperius, L. hirtus,* and *L. utahensis,* males were more susceptible than females. The three species differed in susceptibility, with *L. hesperius* the most tolerant and *L. utahensis* the most susceptible.]

Ostlie, K. R. 1979. *Labops hesperius* Uhler, abundance and dispersal in relation to vegetation. M.S. thesis, Utah State University, Logan. 198 pp.

Paraqueima, O. L. 1977. Some effects of different temperatures on the development of the black grass bug *Labops hesperius* Uhler, from the egg through the adult stage. M.S. thesis, Utah State University, Logan. 84 pp.

Parshley, H. M. 1917. Fauna of New England. 14. List of the Hemiptera-Heteroptera. Occasional Papers of the Boston Society of Natural History 7: 1–125. [*Labops hesperius* is recorded from Maine, New Hampshire, Vermont, and Massachusetts. (Note: Henry and Wheeler (1988) suggest these records apply to *L. hirtus*.)]

Parshley, H. M. 1919. On some Hemiptera from western Canada. University of Michigan. Occasional Papers of the Museum of Zoology. No. 71. 35 pp. [*Irbisia brachycerus solani* and *I. pacificus* (as *Thyrillus pacificus*) are reported from Vernon, British Columbia, Canada.]

Parshley, H. M. 1921. A report on some Hemiptera from British Columbia. Proceedings of the Entomological Society of British Columbia. Systematic Series No. 18: 13–24. [*Labops burmeisteri* and *L. hesperius* are reported from Chilcotin, British Columbia.]

Parshley, H. M. 1922. Report on a collection of Hemiptera-Heteroptera from South Dakota. South Dakota State College, Technical Bulletin No. 2. 22 pp. [*Irbisia brachycera* and *Labops hesperius* are reported from several localities in South Dakota.]

Parsons, G. L., G. Cassis, A. R. Moldenke, J. D. Lattin, N. H. Anderson, J. C. Miller, P. Hammond, and T. D. Schowalter. 1991. Invertebrates of the H. J. Andrews Experimental Forest, Western Cascade Range, Oregon. V: An annotated list of insects and other arthropods. United States Department of Agriculture, Forest Service, Pacific Northwest Research Station, General Technical Report. PNW-GTR-290. 168 pp. [This report documents 3454 species of insects and other arthropods from an old-growth Douglas-fir forest in western Oregon, including *Irbisia cascadia* (as *I. inurbana* Bliven) and *I. serrata,* from grasses in open areas in the forest. *Irbisia cascadia* is distributed in the Coast and Cascade of Oregon and northern California, and *I. serrata* occurs throughout much of western North America.]

Pepper, J. H. 1962. Montana insect pests, 1961 and 1962. 39th Report of the State Entomologist. Montana State College, Agriculture Experiment Station. Miscellaneous Publication. No. 4. 8 pp. [*Irbisia* sp. damaged intermediate wheatgrass in Montana.]

Pepper, J. H., N. L. Anderson, G. R. Roemhild, and L. N. Graham. 1956. Montana insect pests 1955 and 1956. Montana State College, Agricultural Experiment Station, Bulletin 526. 27 pp. [The crested wheat plant bug, *Labops hesperius,* infested crested wheatgrass fields as well as wheat and barley. *Stenodema* sp. damaged tall wheatgrass and crested wheatgrass in Montana.]

Pepper, J. H., J. P. Corkins, L. N. Graham, D. R. Merkley, and N. L. Anderson. 1953. Montana insect pests. 1951 and 1952. Montana State College, Agricultural Experiment Station. Bulletin 484. 34 pp. [The margins of winter and spring wheat fields were damaged by *Labops hesperius* moving from adjacent crested wheatgrass fields. Crested wheatgrass plantings were severely damaged at several locations in Montana and were often killed when the bug infestation was accompanied by grazing.]

Pepper, J. H., J. P. Corkins, R. Schmiedeskamp, C. R. Hunt, N. L. Anderson, and J. C. Wright. 1951. Montana insect pests, 1949 and 1950. Montana State College, Agricultural Experiment Station. Bulletin 474. 35 pp. [*Labops hesperius* occurred throughout southern Montana where it severely damaged planted crested wheatgrass.]

Pepper, J. H., G. R. Roemhild, and L. N. Graham. 1954. Montana insect pests 1953–1954. Montana State College, Agricultural Experiment Station, Bulletin 504: 1–27. [*Labops hesperius* damaged crested wheatgrass fields in Cascade and Chouteau Counties.]

Pepper, J. H., G. R. Roemhild, and L. N. Graham. 1958. Montana insect pests, 1957 and 1958. 37th Report of the State Entomologist. Montana State College, Agricultural Experiment Station. Miscellaneous Publication No. 2. 19 pp. [The crested wheat plant bug, *Labops hesperius,* damaged grass in two Montana counties. *Leptopterna dolabrata* (as *Miris dolobratus*) damaged crested wheatgrass.]

Pepper, J. H., G. R. Roemhild, and L. N. Graham. 1960. Montana insect pests, 1959–60. Montana State College, Montana Agricultural Experiment Station, Miscellaneous Publication No. 3. 11 pp. [*Irbisia* sp. damaged intermediate and crested wheatgrass grown for seed in Montana.]

Perry, E. 1954. New ranges for old. Western Livestock Journal, 32 (July, 1954): 26–27, 39. [This article is a nontechnical review of the use of crested wheatgrasses in western United States.]

Provancher, L. 1885–1890. Petite Faune Entomologique du Canada. Vol. III. Cinquieme Ordre les Hémiptères. Naturalist Canadien. 354 pp. [*Labops hesperius* is reported from Ontario, Canada.]

Rees, N. E. and G. B. Hewitt. 1977. Effects of specific cultural practices on immediate rangeland arthropod populations. Montana State University, Agricultural Experiment Station. Bulletin 695. 38 pp. [Seven sites in northern Montana that had received different rangeland renovation treatments were sampled for insects for three years. Treatments included sagebrush removal, scalping, and interseeding. *Irbisia* sp. (probably *I. serrata*) was reported from four of the seven sites. Additional grass-feeding mirids reported included *Litomiris debilis* (Uhler), *Stenodema vicinum* (Provancher), and *Trigonotylus tarsalis* (Reuter).]

Reuter, O. M. 1879. De Hemipteris e Siberia orientali nonnullis adnotationes criticae. Ofrersigt Finska Vetenskaps-Societatens Förhandlingar 21: 42–63. [Reuter described the genus *Irbisia,* type *Leptomerocoris sericans* Stål. and stated that the genus was allied with *Orthocephaus* Fieber. Reuter also reported *Labops burmeisteri* from Siberia.]

Reuter, O. M. 1890. Adnotationes Hemipterologicae. Revue d'Entomologique 9: 248–254. [The systematic position of *Irbisia* is noted.]

Reuter, O. M. 1896. Dispositio generum palaearcticorum divisionis Capsaria familiae Capsidae.

Ofrersigt af Finska Vetenskaps-Societatens Förhandlingar 38: 156–171. [*Irbisia* is included in a key to the genera of Capsidae (Miridae) of the Palearctic Region. The genus *Thyrillus* is a synonym of *Irbisia*.]

Schuh, R. T. 1975. The structure, distribution, and taxonomic importance of trichobothria in the Miridae (Hemiptera). American Museum of Natural History. Novitates No. 2585. 26 pp. [*Labops burmeisteri* and *L. hirtus* are included in a study of the systematic value of the trichobothria (sensory setae).]

Schwartz, M. D. 1981. A revision of the black grass bug genus *Irbisia* Reuter (Heteroptera: Miridae). M.S. thesis, Orgeon State University, Corvallis. 222 pp.

Schwartz, M. D. 1984. A revision of the black grass bug genus *Irbisia* Reuter (Heteroptera: Miridae). Journal of the New York Entomological Society 92: 193–306. [This modern revision includes keys to 23 recognized species from throughout the range of the genus and synonyms of some names used previously. The genus is characterized and separated from related genera of Miridae. Each species is described and discussed in detail. Habitus drawings of *I. pacifica, I. knighti* and *I. cascadia* are included with morphological drawings of portions of each species. *Irbisia bliveni* and *I. cascadia* are described as new. Detailed information on host plant associations is included for each species as available.]

Schwartz, M. D. and J. D. Lattin. 1983. *Irbisia knighti,* a new mirine plant bug (Heteroptera: Miridae) from the Pacific Northwest. Journal of the New York Entomological Society 91: 413–417. [*Irbisia knighti* is described from the Pacific Coast of British Columbia, Washington, Oregon and northern California. This species, which occupies a very narrow portion of the Vancouveran Zone, was found on *Agropyron repens* (L.) Beauv., *Festuca rubra* L., *Holcus lanatus* L., *Poa pratensis* L., *Poa* sp. and *Carex* sp.]

Slater, J. A. 1950. An investigation of the female genitalia as taxonomic characters in the Miridae (Hemiptera). Iowa State College Journal of Science 25: 1–81. [Details of the sclerotized portions of the female genitalia of *Irbisia sericans, I. shulli, I. pacifica* (as *Thyrillus pacificus*), *Labops hesperius,* and *L. hirtus* are described and illustrated.]

Slater, J. A. 1954. Notes on the genus *Labops,* Burmeister in North America, with the descriptions of three new species (Hemiptera: Miridae). Bulletin of the Brooklyn Entomological Society 49: 57–65, 89–94. [This revision includes descriptions of each species and a key to the species.]

Slater, J. A. 1974. A preliminary analysis of the derivation of the Heteroptera fauna of the northeastern United States with special reference to the fauna of Connecticut. Connecticut Entomological Society, Memoirs, 25th Anniversary, New Haven, pp. 145–213. [A single species (*L. hirtus*) is reported in this biogeographical analysis of northeastern Heteroptera. The genus *Labops* is suggested to have reached North America in post-Pleistocene times.]

Slater, J. A. and R. M. Baranowski. 1978. How to Know the True Bugs (Hemiptera-Heteroptera). W. C. Brown Co., Dubuque, Iowa. 256 pp. [This book contains keys to the mirid genera of the United States, including *Labops* and *Irbisia.* An illustration of *L. hesperius* and a brief discussion of its appearance and distribution are included. Some western species of *Labops* are mentioned as rangeland pests.]

Slosson, A. T. 1895. Additional list of insects taken in alpine region of Mt. Washington. Entomological News 6: 316–321. [*Labops hesperius* is reported from the alpine zone of Mt. Washington, New Hampshire.]

Spangler, S. M. 1984. Arthropod faunas of reseeded rangelands: Effects of vegetation structure. M.S. thesis, Utah State University, Logan. 77 pp.

Spangler, S. M. and J. A. MacMahon. 1991. Arthropod faunas of monocultures and polycultures in reseeded rangelands. Environmental Entomology 19: 244–250. [*Irbisia brachycera* and *Conostethus americanus* (Knight) were the dominant mirid species occurring in grass monocultures. They were present during the early stages of growth when the root reserves of carbohydrates were the lowest. Species richness was lowest in monocultures. Diversifying grass species mixes for reseeding is suggested as a means of reducing plant bug numbers and increasing their natural enemies.]

Stål, C. 1858. Beitrag zur Hemipteren-Fauna Sibiriens und des Russischen Nord-Amerika. Entomologische Zeitung Herausgegeben von dem Entomologische Vereine zu Stettin 19: 175–198. [*Irbisia sericans* is described (in *Leptomerocoris*) from Sitka, Alaska. *Labops burmeisteri* is described from Kamchatka, Siberia.]

Stephens, G. M., III. 1982. The plant bug fauna (Heteroptera: Miridae) of grasses (Poaceae) of the Medicine Bow Mountains and Pole Mountain Ranger District, Wyoming. University of Wyoming, Agricultural Experiment Station, Science Monograph 43. 175 pp. [This analysis of the plant bug fauna found on grasses in southeastern Wyoming includes *Labops hesperius, L. hirtus* and *L. utahensis.* A brief description of the first two species is combined with information on host grasses, grass communities, and general ecological data.]

Stonedahl, G. M. and W. R. Dolling. 1991. Heter-

optera identification: A reference guide, with special emphasis on economic groups. Journal of Natural History 25: 1027–1066. [More than 350 references useful for identifying Heteroptera from around the world are provided.]

Strickland, E. H. 1953. An annotated list of the Hemiptera (S.L.) of Alberta. Canadian Entomologist 85: 193–214. [Five species of *Irbisia* are reported from Alberta: *I. arcuata, I. brachycera, I. solani, I. nigripes* and *I. fuscipubescens.* Two species of *Labops* are reported, *L. hesperius* and *L. verae.* Strickland listed *Labops hirtus* as a synonym of *L. hesperius.*]

Sweet, H. E. 1930. An ecological study of the animal life associated with *Artemesia californica* Less, at Claremont, California. Journal of Entomology and Zoology 22: 57–70, 75–103, 121–151. [*Irbisia sita* is recorded from Claremont, California, from several different plant associations that included *Artemesia.* This early-spring species (March to May) was uncommon.]

Tavernetti, A. A. 1933. Production of the globe artichoke in California. University of California, Berkeley. California Agricultural Extension Service, Circular 76. 24 pp. [*Irbisia solani* is reported as a pest of the globe artichoke in California, the bugs moving onto the crop when the host grasses dried up.]

Thomas, D. B. and F. G. Werner. 1981. Grass feeding insects of the western ranges: An annotated checklist. The University of Arizona, Agricultural Experiment Station. Technical Bulletin No. 243. 50 pp. [Some host and distribution information is provided for *Irbisia brachycera, I. oreas, I. pacifica, I. serrata, I. shulli, I. solani, Labops hesperius, L. hirtus,* and *L. utahensis. Leptopterna ferrugata* fed on seed heads of *Agropyron* sp.]

Todd, J. G. 1973. *Labops hesperius* Uhler: Biology and impact in Oregon rangelands (Hemiptera: Miridae). M.S. thesis, Oregon State University, Corvallis. 91 pp.

Todd, J. G. 1974. Biology of the wheatgrass bug in Oregon rangelands. Society for Range Management. 27th Annual Meeting, Abstract, p. 31. [The life history of *Labops hesperius* was studied on rangeland seeded to intermediate wheatgrass in central Oregon (see Todd and Kamm 1974).]

Todd, J. G. and J. A. Kamm. 1974. Biology and impact of a grass bug *Labops hesperius* Uhler in Oregon rangeland. Journal of Range Management 27: 453–458. [The biology of a univoltine grass bug *Labops hesperius* is outlined for a site in Baker County, Oregon. Winter was passed as an egg in grass straw, eggs hatched in late March, and the nymphs reached the adult stage by late April. About two weeks later, new eggs were deposited in dry grass from the previous year. The nutrient value of the new season's growth of intermediate wheatgrass was reduced about 18% half way through the season; the losses were reduced to 2% by the time the grass had matured. The effect of insect feeding on range productivity varied with rainfall, grazing period, and drought.]

Uhler, P. R. 1871. A list of Hemiptera collected in eastern Colorado and northeastern New Mexico, by C. Thomas, during the expedition of 1869, pp. 471–472. *In* Hayden, F. V., Preliminary Report of the United States Geological Survey of Wyoming and Portions of Contiguous Territories. [*Labops hesperius* and *Irbisia pacifica* are reported without specific localities.]

Uhler, P. R. 1872. Notices of the Hemiptera of the western territories of the United States, chiefly from the Surveys of Dr. F. V. Hayden, pp. 392–493. *In* Hayden, F. V., Preliminary Report of the United States Geological Survey of Montana and Portions of the Adjacent Territories 5: 392–493, United States Government Printing Office, Washington, D.C. [*Irbisia pacifica* (as *Rhopalotomus pacificus*) is described from Montana, and *I. brachycera* (as *Rhopalotomus brachycerus*) and *Labops hesperius* are described from Colorado and Canada (Lake Winnipeg and Great Bear Lake).]

Uhler, P. R. 1876. List of Hemiptera of the region west of the Mississippi River, including those collected during the Hayden explorations of 1873. Bulletin of the United States Geological and Geographical Survey of the Territories 1: 267–361, plates 19–21. [*Irbisia pacifica* (as *Rhopalotomus pacificus*) is reported from Montana, Idaho, and California and *I. brachycera* (as *Rhopalotomus brachycerus*) is reported from California and Colorado. *Labops hesperius* is reported from Colorado, Montana, and Canada.]

Uhler, P. R. 1877. Report upon the insects collected by P. R. Uhler during the explorations of 1875, including monographs of the families Cydnidae and Saldae, and the Hemiptera collected by A. S. Packard, Jr., M.D. Bulletin of the United States Geological and Geographic Survey of the Territories 3: 355–475, 765–801, plates 27–28. [*Labops hesperius* is reported from near Gray's Peak, Colorado.]

Uhler, P. R. 1886. Check-list of the Hemiptera Heteroptera of North America. Brooklyn Entomological Society. 32 pp. [*Irbisia pacifica* (as *Capsus pacificus*), *I. brachycera* (as *Capsus brachycorus*), and *Labops hesperius* are listed all from the "western states."]

Uhler, P. R. 1894. Observations upon the heteropterous Hemiptera of Lower California, with descriptions of new species. Proceedings of the California Academy of Sciences. Second Series 4: 223–295. [The genus *Thyrillus* is described to include

Rhopalotomus pacificus and *R. brachycerus*. (Note: *Thyrillus* Uhler is a synonym of *Irbisia* Reuter.) *Irbisia pacifica* is reported from Lower (Baja) California, southern California, San Francisco, southern Nevada, and Yakima, Washington. *Irbisia brachycera,* reported from Lower California, is considered common in California (state).]

United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine Program. 1951–1975. Cooperative Economic Insect Report. Vol. 1–25. [This weekly series, listing site-specific occurrences of various economic and non-economic insects from throughout the United States, includes occasional references to *Labops* and *Irbisia*.]

United States Department of Agriculture, Animal and Plant Health Inspection Service. Plant Protection and Quarantine Programs. 1976–1980. Cooperative Plant Pest Report. Vol. 1–5. [This series superseded the Cooperative Economic Insect Report cited above.]

Usinger, R. L. 1934. Blood sucking among phytophagous Hemiptera. Canadian Entomologist 66: 97–100. [*Irbisia solani* bit a person in California and produced a small, red spot that persisted for a short time.]

Van Duzee, E. P. 1889. Hemiptera from Muskoka Lake District. Canadian Entomologist 21: 1–11. [*Labops hesperius* is reported from an oat field along the Muskoka River, Canada.]

Van Duzee, E. P. 1905. List of Hemiptera taken in the Adirondack Mountains, pp. 546–556. *In* Felt, E. P., 20th Report of the [New York] State Entomologist for 1904. New York State Museum Bulletin 97. [*Labops hesperius* is reported from Axton, New York, in the Adirondack Mountains.]

Van Duzee, E. P. 1912a. A few days' work and play in Canada. Ottawa Naturalist 26: 68–70. [*Labops hesperius* is reported from Hull, Ontario, Canada.]

Van Duzee, E. P. 1912b. Synonymy of the Provancher collection of Hemiptera. Canadian Entomologist 44: 317–329. [The identity of *Labops hesperius* in the Provancher collection is confirmed. (Note: the Provancher collection is located in Laval University, Quebec City, Canada.)]

Van Duzee, E. P. 1914. A preliminary list of the Hemiptera of San Diego County, California. Transactions of the San Diego Society of Natural History 2(1): 1–57. [*Irbisia pacifica* and *I. brachycera* are reported from San Diego County; the latter species is considered the most common mirid in cultivated regions of southern California.]

Van Duzee, E. P. 1916a. Synoptical keys to the genera of the North American Miridae. University of California Publications, Technical Bulletins, Entomology 1: 199–216. [The keys include *Irbisia* and *Labops*.]

Van Duzee, E. P. 1916b. Notes on some Hemiptera taken near Lake Tahoe, California. University of California Publications, Technical Bulletins, Entomology 1: 229–249. [*Labops hesperius* is reported from Lake Tahoe.]

Van Duzee, E. P. 1916c. Check list of the Hemiptera (excepting the Aphididae, Aleurodidae and Coccidae) of America, north of Mexico. New York Entomological Society, New York. 111 pp. [Distribution information for *Irbisia sericans, I. brachycera, I. solani, I. pacifica* (as *Thyrillus pacificus*), *Labops hesperius,* and *L. burmeisteri* is included.]

Van Duzee, E. P. 1917a. Catalogue of the Hemiptera of America north of Mexico. University of California Publications, Technical Bulletins, Entomology 2: 1–902. [*Irbisia sericans, I. brachycera, I. pacifica* (as *Thyrillus pacificus*), *Labops burmeisteri,* and *L. hesperius* are included.]

Van Duzee, E. P. 1917b. Report upon a collection of Hemiptera made by Walter M. Giffard in 1916 and 1917, chiefly in California. Proceedings of the California Academy of Sciences. Fourth Series 7: 249–318. [*Irbisia californica* (as *I. sericans,* see Schwartz 1984, p. 2–34) is reported from several localities in California. *Irbisia mollipes,* described as a variety of *sericans* from specimans near San Francisco, is now considered a valid species. *Irbisia pacifica* (as *Thyrillus pacificus*) is reported from California.]

Van Duzee, E. P. 1921a. A study of North American grass-bugs of the genus *Irbisia*. Proceedings of the California Academy of Sciences. Fourth Series 11: 145–152. [Six new species of *Irbisia* are described from western North America: *I. arcuata* (a synonym of *brachycera*), *I. californica, I. castanipes, I. parta* (a synonym of *brachycera*), *I setosa,* and *I. sita*. A key is included to the ten known species in the genus (*I. brachycera, I. mollipes, I. sericans,* and *I. solani,* plus the six new species). Distribution information is included with the original descriptions of the six new species and for *Irbisia mollipes*.]

Van Duzee, E. P. 1921b. Insects of the Pribilof Islands, Alaska. Orthoptera, Neuroptera, Hemiptera and Lepidoptera. Proceedings of the California Academy of Sciences. Fourth Series 11: 193–195. [*Irbisia sericans* is reported from St. Paul Island and St. George Island.]

Van Duzee, E. P. 1926. *Labops burmeisteri* Stål. Pan-Pacific Entomologist 2: 163. [*Labops burmeisteri* is recorded from the Adirondack Mountains of New York and comments are made on *L. hirtus*.]

Vosler, E. J. 1913. A new fruit and truck crop pest (*Irbisia brachycerus* Uhler). California (State) Commission of Horticulture. Monthly Bulletin 2: 551–553. [*Irbisia solani* (as *Irbisia brachycera,* see

Schwartz 1984, p. 281) injured garden crops and fruit in California. Damage to lettuce, radishes, onions, peaches and rhubarb is recorded. Weedy plants in uncultivated areas near the crops dried up, resulting in the bugs moving into crops.]

Watts, J. G., E. W. Huddleston, and J. C. Owens. 1982. Rangeland entomology. Annual Review of Entomology 27: 283–311. [This broad overview includes a concise treatment of black grass bugs and other mirids.]

Wheeler, A. G., Jr. and T. J. Henry. 1992. A Synthesis of the Holarctic Miridae (Heteroptera): Distribution, Biology, and Origin, with Emphasis on North America. Entomological Society of America, Thomas Say Foundation, Volume 15, Lanham, Maryland. 282 pp. [*Irbisia sericans* and *Labops burmeisteri* are discussed with information on distribution, host plants, habits, and zoogeography. Distribution maps in North America are included.]

Windig, W., H. L. C. Meuzelaar, B. A. Haws, W. F. Campbell, and K. H. Asay. 1983. Biochemical differences observed in pyrolysis mass spectra of range grasses with different resistance to *Labops hesperius* Uhler attack. Journal of Analytical and Applied Pyrolysis 5: 183–198. [Range grass species and hybrids differing in susceptibilities towards feeding damage by *Labops hesperius* were examined by means of pyrolysis mass spectrometry. Clear correlations between pyrolysis patterns and susceptibility to insect damage were found. A possible attractive role of chloroplast components and a possible repellant role of phenolic moieties that might influence the feeding behavior of the grass bug are suggested.]